

Preparing for the Future:



Development of an Open-Source Workflow for AI-driven Acoustic Data Analysis

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Background

Passive Acoustic Monitoring (PAM) is useful for remote monitoring of marine mammals & marine environment. NOAA PAM archive can address existing and emerging concerns, but this Big Data requires automated data processing. Previous to this effort, each researcher/lab developed individual processing methods. Here we provide a streamlined workflow to allow efficient systematic and comparable data analysis that will facilitate development and adoption of novel ML/AI methods.

Process Data in PAMpal

Create a settings file, identify your Pamguard Databases & Binary Files myPS <- PAMpalSettings() # Prompts user to identify file/folder locations



Extract all your data & run measurements on your Pamquard detections myData <- processPgDetections (myPS, mode='db', id="myData")

Identify the location of your species identifiers (to build training data) myData <- setSpecies(myData, type = "id", method = "pamguard")



myData <- addGps(myData)



Identify & Merge Environmental Data myErddap <- browseEdinfo(var=NULL) #User interface to select data myData <- matchEnvData(myData, nc=myErddap, filename="myEData", buffer=c(.2,.2, 120))



Export data for BANTER banterData <- export banter(myData)



Export Wigner Transform Images for Python Image Classification nerData <-writeWignerData(myData, outDir='wignerData')

Choose A Classifier Model or Develop your Own!

Develop a Machine Learning Classifier (BANTER)

Initialize BANTER model

model banterData<-initBanterModel(banterData)

Create a Detector Model in RANTER

DetModel banterData <- addBanterDetector(model banterData, banterData\$detectors. ntree=20000, sampsize=2, num.cores=1)

Run the full BANTER Event Model

BanterModel_banterData <- runBanterModel(DetModel_banterData, ntree=100000, sampsize=1)

Examine the results

summary(BanterModel banterData)

BANTER (CRAN)



https://cran.r-project.org/web/packages/banter/

PAMpal (Github)

Ming Zhong of Microsoft for Manuel Castellote at NOAA.

ML/AI classifiers inform

downstream data products,

such as habitat models

Acknowledgements PAMpal and BANTER were funded by NOAA's Advanced Science and Technology Working Group.

Survey data funded by multiple institutions, most notably: BOEM, U.S. Navy, and NOAA. BANTER

developed with Eric Archer (SWFSC) and the BelugaSounds AI Image Classifier was developed by



Microsoft/BelugaSound





Summary

FOSSA (Free & Open-Source Software for Acoustics)

- ☑ Series of interrelated software to efficiently process & analyze PAM data
- ☑ Merge Acoustic + GPS, visual observation, & environmental data
- ☑ Export to ML/AI Acoustic Classification Models
- ☑ Import ML/AI classification results with Data

Current Applications

- → Comparable and efficient data analysis (PAMpal)
- → Random Forest ML Classification of beaked whales echolocation (BANTER)
- →- Plug-in to facilitate alternative ML/Al models (e.g., BelugaSounds)

Benefits

- → Facilitate collaborations within and between NOAA Science Centers
- →Encourage use of NOAA data in development of ML/AI models
- → Simple integration of novel ML/AI models into FOSSA via plugins
- → Reduction of labor from months to hours
- → Methods can be applied to other species, geographic regions

Next Steps

- → Share training data to encourage additional ML/AI model development
- → Acoustic Localization Modules
- → Soundscape analysis
- → Population model data products

Al Image Classification (Microsoft/BelugaSound)

Al Image classification developed by Microsoft for NOAA is open-source and available on Github. For each echolocation click we export the images for the Wigner Tranforms using PAMpal:

The BelugaSounds ensemble AI classifier was developed to classify complex beluga calls from spectrogram images.

With modest modification, the classification algorithm can be applied to our wigner transform images of beaked whale echolocation clicks.





For More Info:

NOAA AI Presentations:

Ming Zhong "Improving Passive Acoustic Monitoring Applications to the Endangered Cook Inlet Beluga Whales" (slides here)

Manuel Castellote "Shifting to Al for Passive Acoustic Monitoring of the Endangered Cook Inlet Beluga Whale" (slides here)

Publication: "Beluga whale acoustic signal classification using deep learning neural network models" JASA 2020.

